— The Scribners will publish immediately a small book by George W. Cable, entitled "The Negro Question," containing the address delivered by the author on Washington's Birthday before the Massachusetts Club in reply to the memorable speech by the late Henry W. Grady; also several open letters by Mr. Cable on this subject.

— The Scribners will issue shortly the first of a series of interesting memoirs of "Three Famous French Women," translated from the French of M. Imbert de Saint-Amand, by T. S. Perry. The subject of the first volume will be the Empress Josephine, and will be entitled "The Wife of the First Consul." Other works will follow on Marie Antoinette and the Empress Marie Louise.

## LETTERS TO THE EDITOR.

### Means of increasing the Accuracy of locating Vessels at Sea.

IN looking over some meagre accounts of the recent meeting of the International Maritime Congress, I failed to find any mention of a very important branch of navigation to which my attention was attracted some years ago. I refer to the question of the present accuracy of the instruments for determining the position of a ship at sea, and the steps that must be taken in order to improve this accuracy. The reasons that make this an important matter are so obvious that it is not necessary to catalogue them. I need only say that in approaching any coasts, dangerous reefs, shallow waters, and, in the case of sailing-vessels, the paths regularly frequented by steamers, it is of the greatest importance to be able to locate the ship's position with all the accuracy attainable.

In 1881 Professor W. A. Rogers, the eminent American astronomer and physicist, read a paper before the Naval Institute at Annapolis, published in the "Proceedings" of the institute, bearing the title "The Co-efficient of Safety in Navigation." This paper is spoken of by Commander P. F. Harrington, U.S.N., as being "remarkable for the extent and thoroughness of its investigations, and valuable in the application of its results to the practice of navigation. . . . Its practical conclusion and warning ought to be impressed upon every man who is permitted to lay a vessel course."

In this paper Professor Rogers shows the various errors which enter into the determination of a ship's location at sea; and he determines, finally, an average error and a possible error of position from a large number of observations, as shown by logs of vessels in various quarters of the globe. Upon his inquiring of a number of sea-captains as to the limits within which a ship's place can be ordinarily determined, most of them said a mile was the limit, some few said half a mile, and only one man gave so high an estimate as five miles.

The chief sources of error seem to be those pertaining to the compass, chronometer, and sextant. For the compass, Professor Rogers does not come to any very definite conclusion; at least, no numerical estimates of error are made.

A discussion of the rates of a large number of chronometers shows, that, for a chronometer of average excellence, at the end of twenty days an average error of 3.6 miles must be expected, and an error of 11.5 miles must be looked out for. The error of the chronometer increases with the time occupied in the voyage; and a discussion of the errors of one hundred chronometers by Mr. Hartnup of Liverpool (and probably no more capable man has ever examined into the matter) showed that at the end of a voyage of twelve months the error in one of the ship's positions was 524 miles. Another extreme instance cited is the case of Lord Anson's voyage around Cape Horn, in which one ship "actually made land on the wrong side of the continent, the error of position being over 600 miles."

For the sextant observations it is difficult to determine the limit of accuracy; but "the average error of a single observation at sea is not far from 3 miles, and the average co-efficient

Publications received at Editor's Office, March 17-22.

EARL, A. G. The Elements of Laboratory Work. London and New York, Longmans, Green, & Co. 179 p. 12°. $1.40.
ELECTRICS, Practical: A Universal Handy-Book on Everyday Electrical Matters. London and New York, Spon. 135 p. 18°. 75 cents.
GEDDES, P., and THOMSON, J. A. The Evolution of Sex. New York, Scribner & Welford. 322 p. 12°. $1.25.
HURST, J. T. Spon's Tables and Memoranda for Engineers. 10th ed. New York, Spon. 140 p. 48°. 40 cents.
MAYCOCK, W. P. Practical Electrical Notes and Definitions, for the Use of Engineering Students and Practical Men. London and New York, Spon. 130 p. 24°. 60 cents.
NEW YORK State Board of Health, Eighth Annual Report of the. Transmitted to the Legislature Feb. 27, 1888. Albany, Troy Press Co., pr. 348 p. 8°.
——Same. Ninth Annual Report. Transmitted to the Legislature Feb. 26, 1889. Albany, Troy Press Co., pr. 609 p. 8°.
SPRAGUE Electric Railway & Motor Co., Applications of Electro-Motive Power by the. New York, Sprague Co. 47 p. 8.°
——Stationary Motors, Facts about the. New York, Sprague Co. 31 p. 8°.
STREET Railway Companies, To Managers of. New York, Sprague Electric Railway and Motor Co. 26 p. 8°
TAYLOR, I. The Origin of the Aryans. New York, Scribner & Welford. 339 p. 12°. $1.25.
TUNZELMANN, G. W. de. Electricity in Modern Life. New York, Scribner & Welford. 272 p. 12°. $1.25.

by which this number must be multiplied in order to provide for every contingency of danger is 3.5.''

Having called attention to the accuracy, or rather the inaccuracy, with which a ship's position is found at sea, I wish to make a few suggestions which have occurred to me in the course of my professional work, and which ought, perhaps, to be considered by marine authorities.

In each of our large seacoast cities the Maritime Exchange is the principal place where ship-masters, ship-owners, shippers, marine underwriters, and other men interested in ocean commerce, meet for the purpose of arranging matters connected with the transportation by sea, and it is through these exchanges that the plan I have to propose could be most readily carried out.

What I have to propose is this: that there should be an enforced frequent inspection of the instruments used by ships' officers in determining the positions of vessels at sea.[1] Whether it would be necessary to have a law enacted by legislation, or whether the marine insurance companies would demand such an inspection before issuing policies, or whether the Maritime Exchanges would take up such a work on their account, I cannot more than surmise. I think likely that the former would be necessary; but, as the details of the work would be about the same in any case, I have assumed that the members of the exchanges would be willing to carry on the work without any ''pressure'' from outside.

Let, then, the maritime exchanges of each port adopt a rule that the sextants, compasses, and chronometers of all vessels with which the exchange has dealings shall be inspected every three months, or every six months, or at the close of each voyage, or whatever length of time may be considered sufficient. Let each exchange request the secretary of the navy to assign to duty at its port a sufficient number of officers and men to carry out this inspection. That this last is possible, is shown by the fact that for some years officers of the navy have been assigned to duty at several of these exchanges for the purpose of collecting observations made on shipboard (the United States Signal Service was also represented there in connection with meteorological matters). Probably one lieutenant and two subordinate officers would be sufficient to do all the work necessary for the port of New York. As to the details of such a work as is proposed, there is only space to mention enough to show the necessity of it, and to show its practicability.

Upon the master of a ship reporting his arrival at the exchange, let the naval officer at once take steps to inform himself of the condition of the sextant, chronometer, and compasses carried by the vessel.

The sextant is very easily thrown out of adjustment; and, the errors being determined with great difficulty without proper apparatus, they are usually left for the maker to re-adjust. The result is, that in many cases a sextant is used until it is found to be utterly worthless, and then only is it taken to be repaired.

Let each ship-master be required to show a certificate of examination of his sextant: this to hold good for a stated time, and to be furnished free of charge by the exchange. It would not be such a laborious task as it may seem, to examine the sextants; for, if a Neumayer sextant stand (a description is given in the ''Archiv'' of the Deutsche Seewarte, Jahrgang I. 1878, p. 16) be mounted in a convenient place, it would take the operator but a few minutes to detect the errors in adjustment of a sextant placed thereon, and he could even undertake any minor re-adjustment; but for any serious fault in the instrument it would have to be corrected by an instrument-maker.

The sextants belong to what are known as constant instruments, and may keep unchanged for a long time; but chronometers are variable instruments, and have to be compared with a standard as frequently as possible. This difference in the instruments is so easily and generally recognized, that, while the sextants are so seldom inspected, the chronometers, on the other hand, have been taken to chronometer-shops at the end of each voyage, no matter how short, to have the rate of change determined, and to have the error noted just before the departure on the next voyage. I say ''have been,'' because, much to my astonishment, the leading chronometer-maker of Boston informed me some years ago, and shortly after the Boston time-ball had been established, that this time-ball had about ruined the chronometer-rating business, and that most of the ship-masters (especially those of foreign vessels) rated the chronometer on shipboard by observing the fall of the time-ball at noon of each day. As these time-balls have now been established in the principal ports all over the world, it is safe to conclude that this change in the methods of rating chronometers is universal. I consider that this is a step backward in the progress of maritime science, and that there is much less security against navigators getting out of their ''reckoning'' than existed before this change of method took place. I will state briefly my reasons for thinking this.

1. A chronometer needs frequent inspection by an expert chronometer-repairer in order to see that all parts of the instrument are in good order. By the old method this could be done every voyage when the chronometer was being rated; but now it is probable, that, in cases where a time-ball can be observed, these instruments will not be submitted to the repairer until after experience has shown it to be in a decidedly bad condition.

2. A chronometer cannot possibly be rated as accurately by observations of a time-ball as by the means employed in the regular chronometer-shops. In the former case, observations cannot be made on days with rain or fog; it is quite probable that the same person will not be able to make the comparison for the whole succession of days, and a personal difference of half a second or more may occur between two observers; the error in observing the drop of a time-ball is probably not less than half a second, and many observers would not get the time closer than a second; the time-ball is usually dropped only once daily, so that any error in observing it cannot be detected; the observer on shipboard can have no idea of the errors and the daily changes in the standard clock by means of which the ball is dropped, and must rely implicitly on the accuracy of this signal during spells of cloudy weather, when, as well known, the standard clocks of the best astronomical observatories may be some seconds in error; and if the ship is in port only a brief time, and the chronometer rating should occur during a week when no observations can be made at the observatory, the probability is that a very erroneous rate would be assigned to the chronometer, for use during the coming voyage.

3. In the chronometer-shops the electric time-signals are received from the observatory or standard clock at regular intervals, usually every second or two seconds or minute. The signals are received daily, and comparisons can be made without regard to the weather, so far as distinguishing the signal is concerned. The chronometer comparisons are made by means of a ''hack'' chronometer, which has been accurately compared with the time-signal, and are made by some one person. A skilled man can compare two chronometers without having an error of more than one-tenth of a second, and the comparison can be made several times a day if it is desirable; and this is an important matter if the ship is to be in port only a few days. During cloudy weather, when it is impossible to make astronomical observations, and it sometimes happens that a whole week will pass without an observation being made, it is possible for the chronometer-maker, who usually has on hand a large number of first-class time-keepers, to keep his own standard clock nearer to the true time than that given by the observatory clock, because he relies on the average results given by a large number of time-pieces, while an observatory seldom has more than two. In this case the chronometer-shop rating of a ship's chronometer is much more accurate than that by means of a time-ball. Accidental errors in the standard clock-signals due to occasional mistakes made by the astronomer can be detected (if they are large) by the

[1] This proposal is by no means a new one, but some points which I shall mention in connection with it I have not seen mentioned before.

chronometer-maker, but the navigator rating his own chronometer is easily misled by them.

4. There is still a point to which I wish to make a brief reference; viz., the absolute accuracy of time-singals in general; for this question is one of great importance in rating chronometers. The best data that have yet been obtained for determining this question are the series of daily comparisons of time-signals of the Naval Observatory at Washington, the Cambridge (Mass.) Observatory, and the Allegheny (Penn.) Observatory; this having been done for some years by Mr. James Hamblett of the Gold and Stock Exchange of New York City, in order to regulate the standard clock which furnishes New York with accurate time. The comparisons frequently show differences of two and three seconds between the observatory standard clocks, and I believe instances are not wanting in which the amounts reached even five seconds.

Recognizing that these comparisons could not, perhaps, lay claim to the greatest accuracy attainable, an elaborate plan was matured some years ago by which the United States Signal Service should make a daily comparison of the time-signals of a dozen of our principal observatories, and thus find out with certainty the accuracy attainable by a single observatory, and to inquire into the desirability of the permanent organization of a sort of clearing-house system of time distribution, by means of which a very accurate time-signal could be distributed over the whole country, no matter what the weather might be. For various reasons this plan was not carried out, but its execution is still very much to be desired.

Taking into account the just mentioned facts, and others which might be given, I think that a careful inspection of the ships' chronometers and their rates should be made as frequently as may be found possible. The exact form of this inspection, which might be undertaken by the exchanges, and the best method of securing the greatest accuracy in rating ships' chronometers, cannot be discussed here.

Concerning the compasses on shipboard, I will only say, as has been frequently urged, that they should be examined and tested at every opportunity. The possible errors of the compass have been thoroughly studied, and those existing can be accurately determined; but the subject is too technical to be explained in a few words. FRANK WALDO.

Cincinnati, O., March, 1890.

## Storage-Batteries.

MANY a person who has experimented with secondary batteries has become convinced, as I have, that the Planté form of battery was superior, especially as regards durability, to any of the various batteries in which the "active material" is applied in the form of paste. Realizing that this superiority was mainly due to the relation of the molecules of the active material with each other, and also their relation with those of the support part of the electrode, I was led to make experiments, the outcome of which was a storage-battery, which I have patented. For the sake of illustrating how the Planté form of battery is superior to the pasted forms, I will suppose that a piece of wood represents the support of the pasted plates, and that sawdust represents the oxide which is to be applied to the support part of the electrode in the form of a paste. The sawdust may be mixed with this, that, or the other liquid, and made to adhere to the wood, to a greater or more likely to a lesser extent. I immerse this wood electrode, if I may be allowed to call it such, in sulphuric acid: the sawdust will fall off in a comparatively short time, leaving the wood support to a more gradual destruction. If the surface of wood could be changed in some way so that it would resemble sawdust, and yet in such a way that the molecules of this changed surface preserve to a considerable extent their original relation with each other (that is to say, their original attraction for each other), and at the same time preserve their attraction for the molecules of the unaltered portion, we would then have a wood electrode (I apologize for the term) which would resemble the lead electrode of Planté. Almost invariably, when the pasted electrodes peel, they do so, not from the surface of the "active layer," but from the surface of the support metal. I have experimented with but one Planté battery, which, by the way, was the first storage-battery that I ever made. This battery was charged to its greatest possible capacity many times, and also discharged suddenly, but the active layer has not peeled from the non-oxidized portion of the lead plate. There has been at times a falling of fine particles of peroxide, but no peeling such as you get in pasted batteries.

The sooner storage electricians recognize that the greater the attraction of the molecules of a secondary electrode for each other, the more durable will the electrode be, the better for all concerned. Just as soon as storage electricians recognize the fact that the quality of a storage-battery is to be judged, not by the amount of peroxide the electrodes contain, but by the degree of attraction which exists between the molecules of the active layer, their experiments will be more fruitful, and the pasted plates of to-day will be no more. The problem is not how to store oxygen, but how to increase the affinity of each molecule of an oxide for its neighbor. Hoping that these remarks will set the readers of *Science* a-thinking, and that they may have some weight towards convincing them that all that is necessary in a good storage-cell is molecular affinity, I close my communication with great faith in the future of storage electricity.

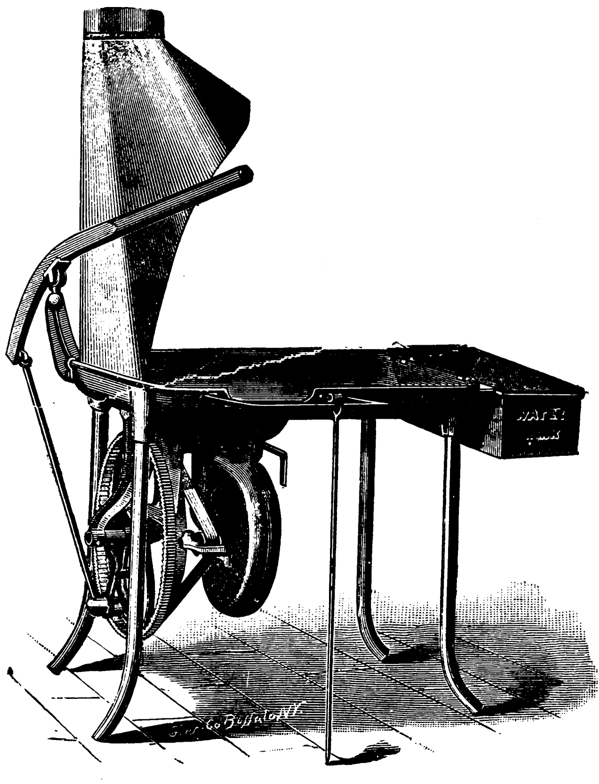
N. B. ALDRICH.

Fall River, Mass., March 18.

# INDUSTRIAL NOTES.

## Buffalo Blacksmith's Forge.

FEW progressive blacksmiths or metal-workers who look into the matter fail to acknowledge the superiority of the modern portable forge over the bellows and stationary blast-forge. By



A NEW BLACKSMITH'S PORTABLE FORGE.

the use of an improved portable forge, heat is produced more quickly and with less labor and cost. The portable forge also takes less space, while, so far as durability and reliability are concerned, a comparison between the two is much to the disadvantage of the old style. The first cost of the brick forge is greater, and subsequent repairs and occasional movings make a considerable item of expense, while repairs are seldom required on an improved portable forge; and it may be moved from one part of the shop to another with little trouble.